

Claims

- [c1] 1.A chainable Universal-Serial-Bus (USB) flash-memory drive comprising:
- a drive substrate having wiring traces for electrically connecting components;
- a USB hub, mounted on the drive substrate, having a host port and a plurality of device ports;
- a male USB connector mounted on the drive substrate, connected by the wiring traces to the USB hub;
- a female USB connector mounted on the drive substrate, connected by the wiring traces to the USB hub;
- a flash controller mounted on the drive substrate, connected by the wiring traces to one of the plurality of device ports of the USB hub; and
- a flash memory mounted on the drive substrate, connected by the wiring traces to the flash controller, for storing data received by the USB hub through the host port,
- whereby the drive substrate has mounted thereon the male USB connector, the female USB connector, the USB hub, the flash controller, and the flash memory.
- [c2] 2.The chainable USB flash-memory drive of claim 1

wherein the male USB connector connects to the host port of the USB hub;
wherein the female USB connector connects to one of the plurality of device ports of the USB hub.

- [c3] 3. The chainable USB flash-memory drive of claim 2 wherein the female USB connector can connect to the male USB connector of a downstream chainable USB flash-memory drive allowing a host connected to the male USB connector of the chainable USB flash-memory drive to read flash memory from either the chainable USB flash-memory drive or from the downstream chainable USB flash-memory drive,
whereby the chainable USB flash-memory drive can be daisy-chained to the downstream chainable USB flash-memory drive.
- [c4] 4. The chainable USB flash-memory drive of claim 3 further comprising:
a daughter-card that has a flash controller and a flash memory mounted thereon;
a socket on the drive substrate, the socket connected to one of the plurality of device ports of the USB hub by the wiring traces;
secondary connectors on the daughter-card for fitting into the socket on the drive substrate,
whereby expansion of flash memory is provided by the

daughter-card.

- [c5] 5.The chainable USB flash-memory drive of claim 4 wherein the secondary connectors on the daughter-card comprise metal contact pads along a long edge or along a short edge of the daughter-card, or comprise metal posts or a female connector plug.
- [c6] 6.The chainable USB flash-memory drive of claim 3 further comprising:
 - a daughter-card that has a flash memory mounted thereon;
 - an expansion flash controller mounted on the drive substrate and connected to one of the plurality of device ports of the USB hub by the wiring traces;
 - a socket on the drive substrate, the socket connected to the expansion flash controller by the wiring traces;
 - secondary connectors on the daughter-card for fitting into the socket on the drive substrate,
whereby expansion flash memory is mounted on the daughter-card but the expansion flash controller is mounted on the drive substrate.
- [c7] 7.The chainable USB flash-memory drive of claim 6 wherein the secondary connectors on the daughter-card comprise metal contact pads along a long edge or along a short edge of the daughter-card, or comprise metal

posts or a female connector plug.

- [c8] 8.The chainable USB flash-memory drive of claim 3 wherein the drive substrate is a multi-layer printed-circuit board (PCB).
- [c9] 9.The chainable USB flash-memory drive of claim 3 wherein the male USB connector and the female USB connector are mounted on opposite edges of the drive substrate.
- [c10] 10.A daisy-chainable flash card comprising:
 - a printed-circuit board (PCB) substrate;
 - a hub controller mounted on the PCB substrate, the hub controller having a host port, a first device port, and a second device port, the hub controller forwarding commands and data to and from the host port and the first device port or the second device port;
 - a male connector mounted on the PCB substrate and connected to the host port of the hub controller for insertion into a female connector on a host;
 - a female connector mounted on the PCB substrate and connected to the first device port of the hub controller, for receiving a male connector on a downstream device;
 - a flash controller connected to the second device port of the hub controller; and
 - a flash memory connected to the flash controller, for

storing data from the host,
wherein the hub controller routes data from the host to
the flash controller for storage by the flash memory
when the host addresses local flash memory, but the hub
controller routes data from the host to the female con-
nector when the host does not address the local flash
memory.

- [c11] 11.The daisy-chainable flash card of claim 10 wherein
the flash controller and the flash memory are chips
mounted on the PCB substrate.
- [c12] 12.The daisy-chainable flash card of claim 10 wherein
the flash controller is mounted on the PCB substrate but
the flash memory is mounted on a daughter-card;
further comprising:
a socket on the PCB substrate for receiving a connector
on the daughter-card,
wherein the flash memory connects to the flash con-
troller through the connector and the socket.
- [c13] 13.The daisy-chainable flash card of claim 10 wherein
both the flash controller and the flash memory are
mounted on a daughter-card;
further comprising:
a socket on the PCB substrate for receiving a connector
on the daughter-card,

wherein the flash memory is connected to the flash controller which connects to the hub controller through the connector and the socket.

- [c14] 14. The daisy-chainable flash card of claim 10 wherein the male connector is a male USB connector, the female connector is a female USB connector, and the hub controller is a USB hub controller.
- [c15] 15. The daisy-chainable flash card of claim 10 wherein the male connector is a male IEEE 1394 connector, the female connector is a female IEEE 1394 connector, and the hub controller is a IEEE 1394 hub controller.
- [c16] 16. The daisy-chainable flash card of claim 10 wherein
 - the male connector is a male secure-digital connector, the female connector is a female secure-digital connector, and the hub controller is a secure-digital hub controller, or
 - the male connector is a male compact-flash connector, the female connector is a female compact-flash connector, and the hub controller is a compact-flash hub controller, or
 - the male connector is a male memory-stick connector, the female connector is a female memory-stick connector, and the hub controller is a memory-stick hub controller, or

the male connector is a male multi-media-card connector, the female connector is a female multi-media-card connector, and the hub controller is a multi-media-card hub controller, or

the male connector is a male USB Express Card connector, the female connector is a female USB Express Card connector, and the hub controller is a USB Express Card hub controller, or

the male connector is a male PCI Express Card connector, the female connector is a female PCI Express Card connector, and the hub controller is a PCI Express Card hub controller.

- [c17] 17. An expandable flash card comprising:
- substrate means for physically supporting and electrically connecting components mounted thereon;
 - male protocol connector means, attached to the substrate means, for plugging into a female protocol connector on a host;
 - female protocol connector means, attached to the substrate means, for receiving a male protocol connector on a downstream device;
 - protocol hub controller means, mounted on the substrate means, for routing protocol data from the host to an addressed port in a plurality of ports;
 - first memory means, mounted on the substrate means,

for storing the protocol data from the host when the host addresses a port on the protocol hub controller means for the first memory means; and pass-through means for passing the protocol data from the host through to the female protocol connector means when the host addresses a port that is not in the plurality of ports of the protocol hub controller means, whereby protocol data is stored on the first memory means mounted on the substrate means, or is passed through from the male protocol connector means to the female protocol connector means.

- [c18] 18. The expandable flash card of claim 17 wherein:
- when a protocol is a USB protocol, the male protocol connector means is a male USB connector means, the female protocol connector means is a female USB connector means, the protocol hub controller means is a USB hub controller means, and the protocol data is USB data, or
- when a protocol is a firewire protocol, the male protocol connector means is a male firewire connector means, the female protocol connector means is a female firewire connector means, the protocol hub controller means is a firewire hub controller means, and the protocol data is firewire data.

- [c19] 19.The expandable flash card of claim 18 further comprising:
socket means, connected to a second of the plurality of ports of the protocol hub controller means, for receiving a daughter-card containing a second flash memory means for storing the protocol data from the host when the host addresses a port on the protocol hub controller means for the second memory means.
- [c20] 20.The expandable flash card of claim 18 wherein the protocol hub controller means further comprises address decode means for detecting and decoding protocol addresses received from the host over protocol data lines.
- [c21] 21.The expandable flash card of claim 20 further comprising a downstream expandable flash card that comprises:
downstream substrate means for physically supporting and electrically connecting components mounted thereon;
downstream male protocol connector means, attached to the downstream substrate means, for plugging into the female protocol connector means;
downstream female protocol connector means, attached to the downstream substrate means, for receiving a male protocol connector on a further downstream device;
downstream protocol hub controller means, mounted on

the downstream substrate means, for routing protocol data from the host to an addressed port in a second plurality of ports;

downstream first memory means, mounted on the downstream substrate means, for storing the protocol data from the host when the host addresses a port on the downstream protocol hub controller means for the downstream first memory means; and

downstream pass-through means for passing the protocol data from the host through to the downstream female protocol connector means when the host addresses a port that is not in the second plurality of ports of the downstream hub controller means and is not in the plurality of ports of the protocol hub controller means, wherein the downstream expandable flash card is removable from the expandable flash card.